ECE 313

Probability with Engineering Applications
Section E
Y. Lu
Logistics

- MWF 2pm

- Text: ECE 313 course notes
  - Hard copy sold through ECE Store
  - Soft copy available on the course website
    https://courses.engr.illinois.edu/ece313
Grading

- 10% Homework. MasterProbo checkpoints
- 50% Midterm exams (2 @ 25% each)
- 40% Final Examination
Exams

- Final: Monday, December 18, 7-10 p.m.
  - 2 cheat sheets

- Midterm Exam I: Wednesday, October 11, 8:45 p.m.-10 p.m.
- Midterm Exam II: Wednesday, November 15, 8:45 p.m.-10 p.m.
  - 1 cheat sheet

- Info on course website
MasterProbo

- Online homework
- Pass checkpoint by Tuesday 11:59pm
  - First checkpoint: 9/12
MasterProbo

All information available at

https://courses.engr.illinois.edu/ece313/Homework.html

Please read carefully
FAQ

Q: How do I access MasterProbo?

Follow the link on course page:
https://courses.engr.illinois.edu/ece313/Homework.html
FAQ

Q: How do I access MasterProbo?

(cont’d) Enter your NetID and a preferred password. You will receive an activation e-mail in your illinois mailbox. Follow the link to activate your account.

Warning: Please disable forwarding your illinois e-mail to 163.com. Activation e-mails are rejected by 163.com. There is no way we can send you the activation link unless you disable it.
FAQ

Q: What happens if I didn’t pass a checkpoint by the deadline?

A: Pass – 10 points

otherwise: \[
\frac{\text{# probos earned}}{\text{total # probos for this checkpoint}} \times 10
\]

Only top 9 out of 12 scores will be used to compute grade
No extension of deadlines
Tech support

Best way to report a problem

What is the number of six letter sequences that can be obtained by ordering letters of the set \{A, A, B, B, B, C\}? For example, ACBBAB is a possibility.
Tech support

Other issues:
Such as “can’t register. Says I’m not enrolled”

E-mail: masterprobos@gmail.com

With proper headings to expedite response
[enrollment]
[technical]

Do NOT e-mail individual professor or TA
Questions?
Learning Probability
Probability theory is nothing but common sense reduced to calculation.

- Pierre Laplace, 1812
Prosecutor’s Fallacy
Prosecutor’s Fallacy

Suppose a crime has been committed. Blood is found at the scene for which there is no innocent explanation. It is of a type which is present in 1% of the population.

The prosecutor claims: “There is a 1% chance that the defendant would have the crime blood type if he were innocent. Thus there is a 99% chance that he’s guilty.”

What is wrong with this argument?
Math - A cleaner language:

Let $B$ be the event that the defendant has the crime blood type.
Let $G$ be the event that he is guilty.

The prosecutor’s statement reduces to:

$P(B \mid G^c) = 0.01$

$1 - P(B \mid G^c) = P(B^c \mid G^c) \neq P(G)$
Blood Test
Blood Test

- If my blood test is positive, and I am told that the false positive probability of the test is 0.1

- What is the probability that I am truly positive?

- Concepts: hypothesis testing
Language vs. Problem-solving

What is

Sample space
False positive
Independence

?
MasterProbo

- Your *personal coach* for probability
- Focus you on *problem-solving*
- Detect your *weakness* and practice *adaptively*
MasterProbo

- Best practice:
  - Basic familiarity with concepts (lecture, notes, videos)
  - Start early in the week
  - Concepts need time to consolidate in your mind

- If stuck on a problem, get to the bottom of it!
  - Think about each hint: let it stimulate your thinking
  - Review notes
  - SOS request (online office hours 7-9pm except Fri, Sat)
Procedure vs. Problem-solving

• An exact plan of attacking a certain type of problems
  Fine for problems you’ve seen before

But

the ultimate aim is to solve problems not seen before
Machine Learning
Human Learning vs. Machine Learning

- Can only solve the problems seen before
- *Collect* and *remember* as many problems as possible
  
  Lead to memory problem

- Learn problem-solving

Machine Learning

- Overfitting
- Increase sample size

- Aim to generalize to unobserved samples
Plan for class

- Mon: Lectures explaining concepts
  - Learn the ‘language’
  - How concepts connect together

- Wed, Fri: Problem solving
Probability
Uncertainty
Fair coin

- Coin toss: most widely used source of uncertainty
- Random experiment
- **Outcome**: Head (H), or Tail (T)
- All possible outcomes: { H, T } (sample space)
- It’s fair if \( P(H) = P(T) = \frac{1}{2} \)
Language

- **Outcome**: Head (H), or Tail (T)

- **Sample space**: set of all possible outcomes: H, T

- It’s *fair* if $P(H) = P(T) = \frac{1}{2}$
What can we say about the outcome of a coin toss?
Head or tail?
Unpredictable
But...
There is *certainty* in uncertainty.
We know that if we repeat the experiment 10000 times
$P(\text{more than 5150 H}) \approx 0.0013$

(Concepts: Bernoulli, Binomial, Gaussian approximation)
Polling
Polling

- What does it mean if the poll says a candidate wins with 29% - 31% probability, with 96% confidence?

- Does it mean the real portion of votes the candidate wins is within 29% - 31% with 96% probability?

- Ans: no.
Quantitative Finance
Portfolio diversification

- Modern portfolio theory (MPT) 1990 Nobel economics
- Markowitz’s bullet
Portfolio diversification

- Chapter 4
- Concepts: mean, variance, correlation
Safety video

http://police.illinois.edu/emergency-preparedness/run-hide-fight/